Short Course on the Fundamentals of Boundary Layer Wind and Temperature Profiling using Radar and Acoustic Techniques

February 8-9, 2003

Profiler Siting Considerations, Interference Sources, Installation and Maintenance – Radar

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Overview

- Siting considerations for wind profilers and RASS
- Clutter/RFI
- Electrical power
- Communications
- Equipment shelters
- Site monitoring and maintenance

Profiler Siting Considerations

Questions to answer prior to choosing a site:

- Are there minimal clutter sources?
- Is reliable power and phone service available?
- Does the location meet the project goals?
- Is the landowner amenable to a long-term lease?
- Is there sufficient security?
- Will the operation of RASS disturb anyone?

Best Locations for a Profiler Site

Small to medium sized airports

- Minimal clutter
- Good security
- Availability of power and phone
- Low leasing costs
- RASS is not a problem
- FAA clearance is usually not a problem (FAA Form 7460-Notice of proposed construction or alteration)

Other good sites:

Wastewater treatment plants

Government or university research labs

Difficult locations for a profiler site

Urban Areas
- Clutter
- RFI
- Security issues
- RASS noise

Environmentally sensitive areas (National Parks, wildlife refuges, open space)
- Visual impact
- RASS noise
- Permitting

Power Plants
- Clutter
- Access
- Space availability

Clutter Targets

As a general guideline use the 5 degree rule: Clutter targets should not extend more than 5 degrees above the horizon.

Examples of Clutter Sources

- Roads that are heavily traveled or elevated highways and overpasses
- Trees either close in or on hillsides
- Constant air traffic
- Birds
- Ocean waves
- Power lines
- Transmission towers

When clutter cannot be avoided:

Orient the clutter sources off the corners of the radar antenna.

Switch operation from 5-beam to 3-beam.

Interference Sources

- RFI
- Cell phone towers
- Cell phones

Once a potential site has been selected it is always a good idea to use a radio frequency scanner to identify sources near the profiler frequency. Scan the 902-928 MHz range. Although the scanner is not as sensitive as the radar, it may help to identify potential interference sources within the profiler's bandwidth.

Radio Acoustic Sounding System (RASS)

RASS greatly complicates profiler siting!

RASS Siting

- Atmospheric conditions determine the distance the sound can be heard
- In flat terrain try to allow at least 1 km distance between the RASS source and any business or residence
- In hilly or mountainous terrain sound can travel a long distance because of reflections and sound ducting – if houses are within 2 km and located at an elevation greater than the RASS sources, the sound will be a problem, at least during the nighttime hours.

Solution - Consequence:

- Turn down the amplifier volume – lose height coverage
- Set the timer so RASS operates during selected hours – lose RASS information at times when it may be most valuable.

Electrical Power

Type of installation depends on whether the profiler site is temporary or semi-permanent

Semi permanent site:

- Permits (County, City)
- Request for service from power provider
- Establish account
- Installation of transformer, poles, wire, and meter
- Private contractor to install meter socket and disconnect, and to connect electrical to equipment shelter.
- Final inspections

Total costs will depend on distance to power source but can run from $7.5 K to $20 K plus monthly electrical usage charges

Temporary site:

- Connect to existing source and compensate owner for usage

  Cost for electrician to connect from existing source to equipment shelter usually $1 K to $2.5 K. Compensate at ~ $0.1 K per month for usage.

  Typical power requirement is 120/240 V 40 amp service

Communications

- Phone (land line)

  Usually available

  Low cost (installation ~$200 + $50 per month usage)
- Cell phone

  Alternative if a land line is unavailable, can be expensive if used frequently
- Satellite phone

  Expensive ($3 K for hardware + $1 - $1.50 per minute airtime)
- GOES

  Initial cost is $3 K for hardware but airtime is free. You must demonstrate a need and a transmit window needs to be available. The new system will transmit at 9600 baud (currently 100 – 300 baud)

Equipment Shelters

Semi-permanent sites:

- Use Vaisala guidelines

Temporary sites:

- Mobile office trailers (8’ x 20’), cost is ~ $200 per month plus ~ $1000 for delivery, setup, and tie downs.
- Equipment trailers (6’ x 10’) with AC, heat, lights, receptacles, and insulation costs ~ $5 K.

NOAA/ETL Installation at San Nicolas Island, California

Winter Profiler/RASS Operations

- Placing canvas covers, supported by 2 X4's, over antennas prevents most snow from collecting on the antennas.
- The only solution for RASS is to either cover the antennas during snowstorms or dig the snow out of the antennas

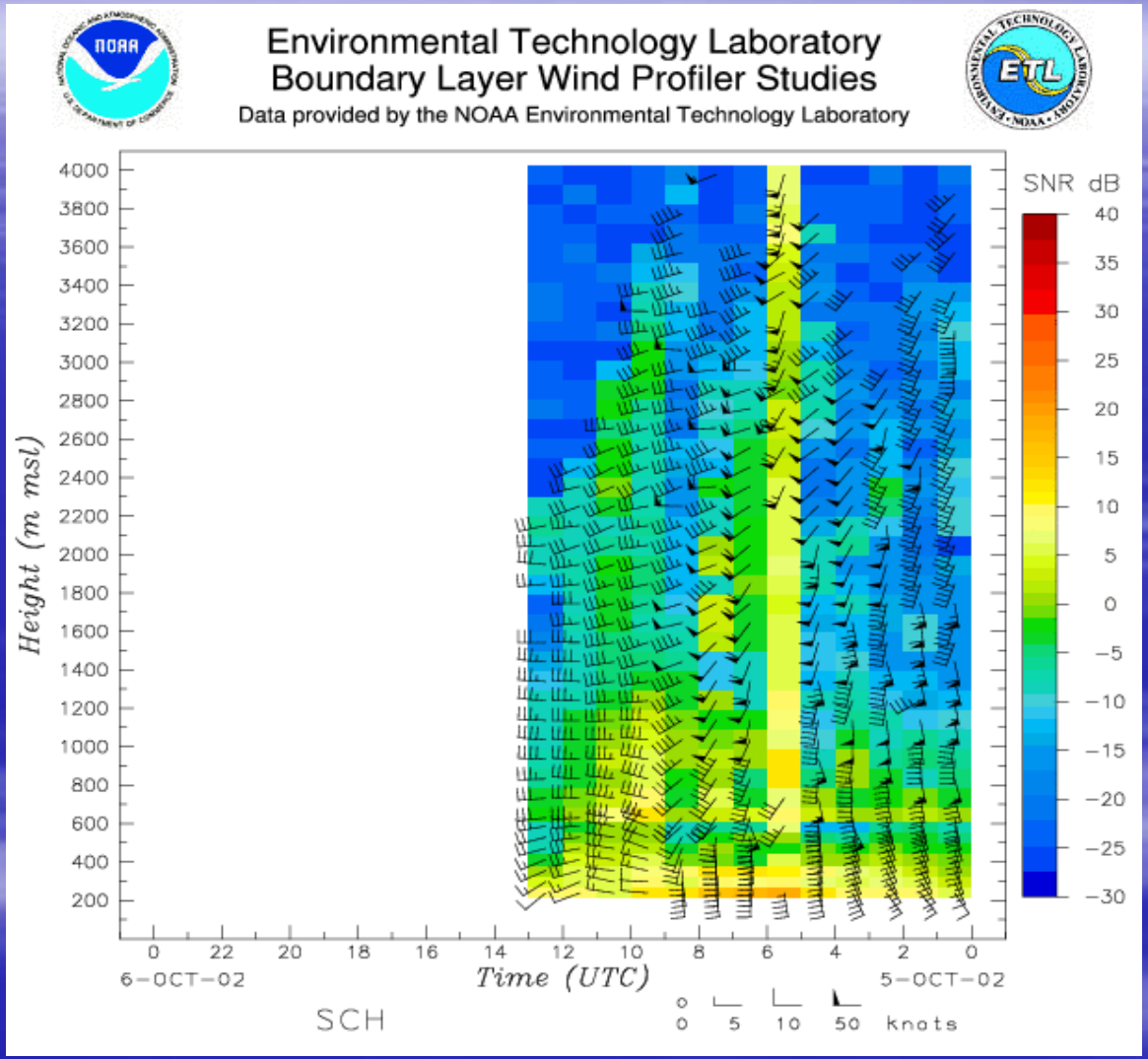
Concord, New Hampshire

Site Maintenance

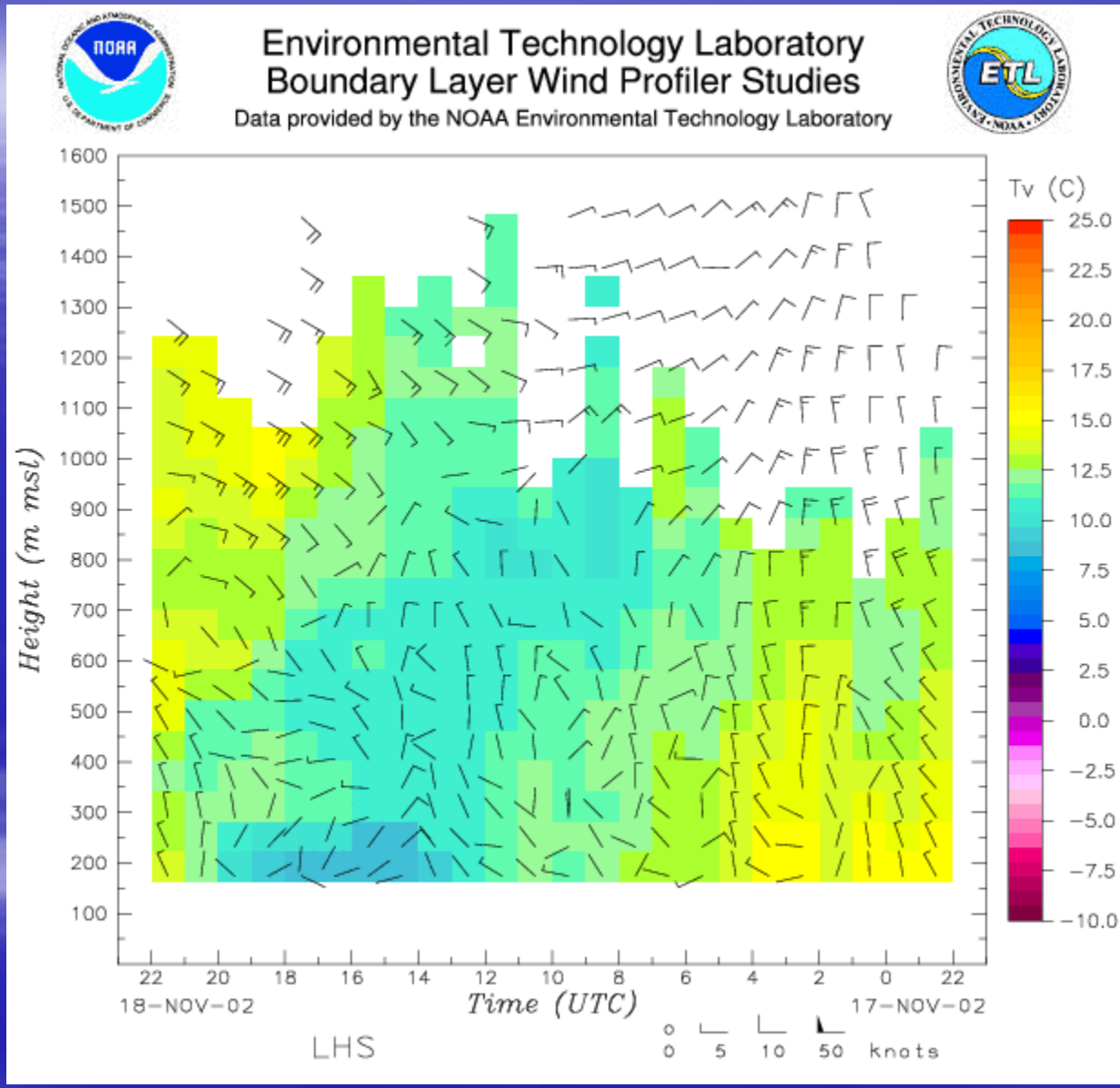
- Monitor data daily using NOAA/ETL Web display
- Site visits at 4 – 6 week intervals
- Site checklist

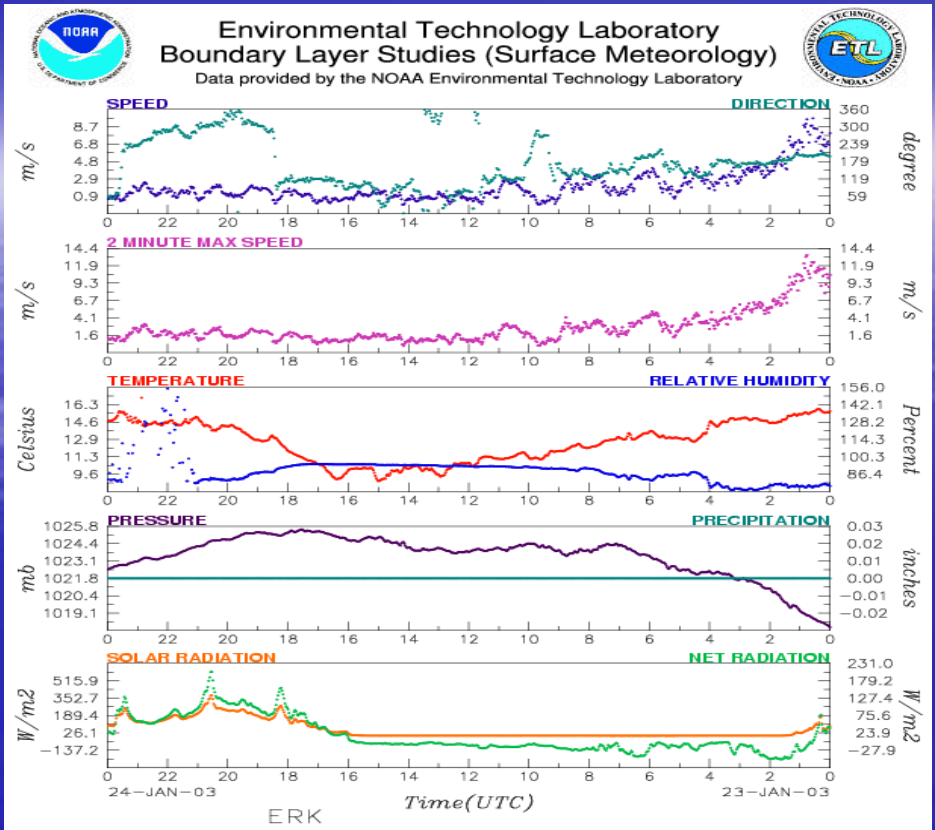
Keep an eye on your data!

- Observing the data daily allows you to identify a problem as simple as a blown fuse in the radar electronics. This allows you to repair the problem quickly with a minimal loss of data.



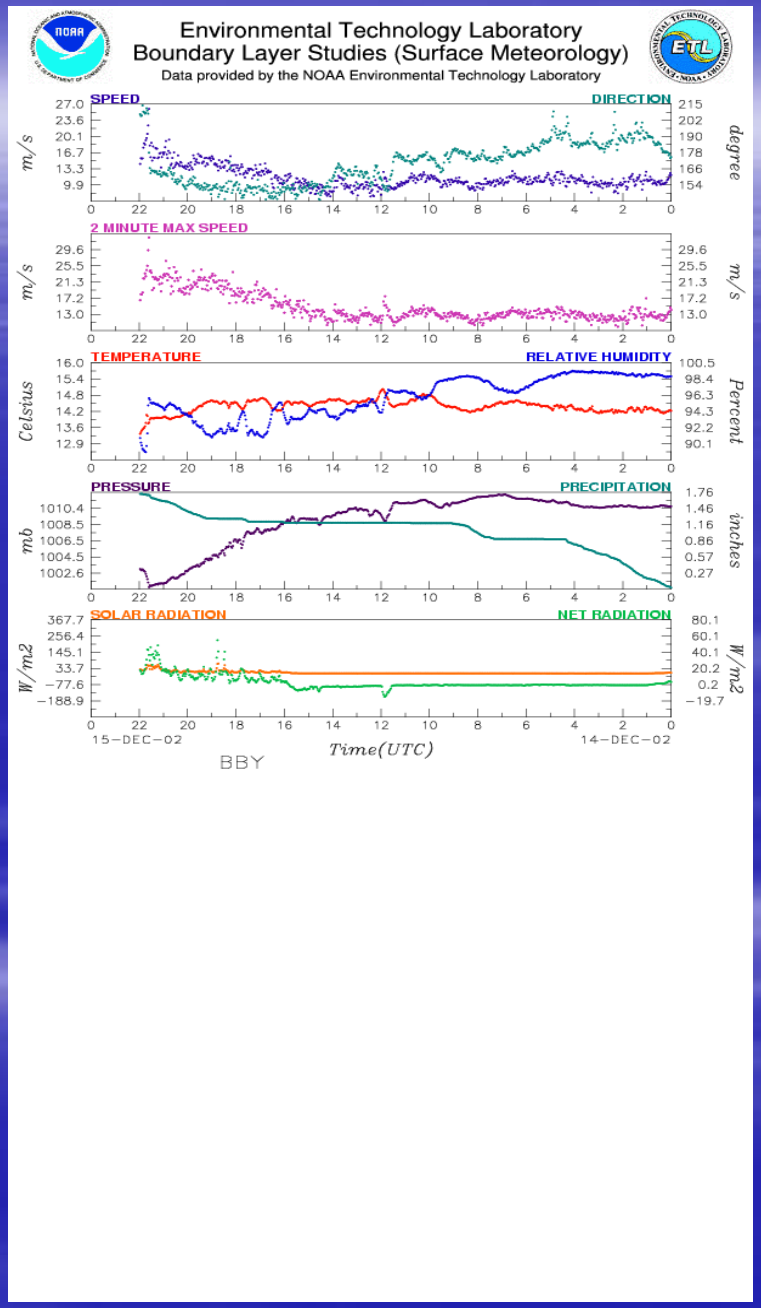
Accounting for changes in the meteorological conditions, a sudden change in the height of RASS coverage may indicate either a blown voice coil or water, snow, or debris collecting in the RASS dishes





- In this case the relative humidity sensor goes bad at 2100 UTC. Again, by keeping an eye on the data, repairs can be made quickly.

When the winds gust over 30 m/s and the data stops coming in, you know you have big problems



A site checklist provides documentation of your site visit. It is always important to follow a regular procedure on each visit to document any problems or changes.

NOAA/ETL PROFILER, RASS, AND MET TOWER SERVICING CHECKLIST
SBCAPCD

Site Name: GLA_____ Operator:_____

Date:_____ Time (UTC):_____ Julian Day:_____

A. Profiler Check

LapXM running? YES NO

Noise floor at 20 dB? YES NO

Are all RASS sources transmitting ? YES NO

Time LapXM shut down for ? (UTC) _____

Check clock (Shift F1) Time (UTC) _____ Time Standard (UTC) _____

Time adjusted to standard? YES NO

Check antenna angles (Alt F3)

Antenna #1 _____ Compass _____ Adjusted ? YES NO

Antenna #2 _____ Compass _____ Adjusted ? YES NO

Check RASS temperature (F5) Min _____ Max _____

Adjusted YES NO New Min _____ New Max _____

Backup Drive # _____ Days backed up _____ To _____

LapXM started at _____ UTC Julian Day _____

NOAA/ETL uses calibrated standards for comparison with their meteorological instrumentation.

B. Meteorological Tower Check

Pressure (AIR handheld) #____ Pres _____ mb

Pressure (met) Model _____ SN _____ Pres _____ mb

Pyranometer: Leveled YES NO

Pyranometer check: Standard _____ W m^{-2}

LI-200 SN _____ _____ W m^{-2}

2-m Temperature/RH check: Standard _____ ^{O}C _____ %

T/RH sensor: Model _____ SN _____ _____ ^{O}C _____ %

Aspirated shield: Fan Operational? YES NO Solar Panel Cleaned? YES

Net Radiometer: SN_____ Leveled YES NO Cleaned: YES NO

Replaced domes? Top: YES NO Bottom: YES NO Time: _____

Tipping Bucket: Leveled? YES NO Cleaned?: YES NO

Tipped? YES NO # of tips? ____ Time Tipped? _____

Wind Direction: SN_____ Sensor direction _____ Compass _____

Adjusted YES NO

Battery: _____ Volts

Check guy cables YES NO

Datalogger Time _____ UTC Time Standard _____ UTC

Adjusted? YES NO

Always add comments to the checklist. They may seem unimportant at the time but often come in handy when post-processing the data or answering an auditors inquiries.

C. Hardware Check

Clutter fences level	YES	NO
Tighten guy wires	YES	NO
Power and signal cables OK	YES	NO
RASS enclosures OK	YES	NO
RASS cables OK	YES	NO
RASS dishes level and clean	YES	NO
RASS sources level	YES	NO
RASS power output at 10 V	YES	NO

D. Before leaving

Monitors turned off? YES AC turned on? YES

E. Comments _____

Summary

Usually, no site is perfect, but for successful measurements you will need to have answered “yes” to most of the following questions:

- Are there minimal clutter sources?
- Is reliable power and phone service available?
- Does the location meet the project goals?
- Is the landowner amenable to a long-term lease?
- Is there sufficient security?
- Will the operation of RASS disturb anyone?